

Impact of Training and Work Environment on Agricultural Extension Workers' Performance and Rice Productivity in Rajagaluh District, Indonesia

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Abstract: Background: Agricultural extension plays a central role in helping farmers raise productivity by linking them with new ideas, farming techniques, and relevant technologies. The effectiveness of these services depends greatly on the people who deliver them. In particular, how well extension workers perform their duties is shaped by the kind of training they receive and the situation in which they work. When these two elements are well managed, extension staff are usually more capable of providing timely and practical assistance to farming communities. Objective: The purpose of this research is to explore how training and the work environment influence the performance of agricultural extension workers and to understand how these factors relate to rice production outcomes in the Rajagaluh District of Indonesia. Methods: This study applied a quantitative descriptive–verificative approach and involved all 52 agricultural extension officers working in the district. Data were gathered through a structured questionnaire and supported by field observations. Statistical analysis was carried out using multiple regression to test the relationship between variables, the F-test to examine their combined influence, and a paired t-test to compare rice productivity data from 2022 and 2023. Results: The analysis showed that training and the work environment, when considered together, significantly improved extension worker performance ($R^2 = 0.562$, $p < 0.05$). When the two variables were tested separately, the effect of each was not statistically significant. However, the paired t-test demonstrated a clear and meaningful rise in rice yield between 2022 and 2023, suggesting that better training opportunities and working conditions contributed to improved productivity. Conclusion: Overall, the study highlights the importance of well-planned training programs and supportive workplaces in strengthening the capacity of agricultural extension officers. When extension staff are well prepared and work in an encouraging environment, they are more effective in guiding farmers, which eventually results in better crop performance and supports the broader goal of sustainable agricultural development.

Keywords: Training; Work Environment; Agricultural Extension; Performance; Rice Productivity; Indonesia



1. Introduction

Agricultural extension services have long been recognized as a cornerstone of efforts to strengthen food security and promote sustainable agricultural growth. These services function as a crucial link between scientific research and the everyday practices of farmers. By facilitating the flow of agricultural innovations, technologies, and management strategies from research institutions to rural communities, extension services ensure that scientific progress reaches those who depend on farming for their livelihoods. Through this process, farmers gain access to knowledge that enables them to increase productivity, conserve resources, and adapt to evolving environmental and market challenges. In practice, extension services not only introduce new technologies but also help farmers understand how to apply them effectively within their own social and economic contexts.

The success of any agricultural extension system depends heavily on the people who implement it at the local level. Extension officers—often working directly with farmers in diverse and sometimes difficult conditions—serve as the bridge between policy goals and practical outcomes. Their performance therefore determines how efficiently new ideas and practices are transferred to the field. When extension officers are knowledgeable, motivated, and well supported, they can play an instrumental role in enhancing farm productivity and improving rural livelihoods. However, if they lack adequate training, resources, or institutional support, the potential benefits of extension programs are significantly reduced. The competence and morale of these workers thus remain central to the broader goal of agricultural transformation.

Among the numerous factors influencing the performance of agricultural extension personnel, **training and work environment** stand out as particularly critical. Training equips extension agents with updated technical knowledge and practical skills that help them solve farmers' problems in real time. It also builds confidence and communication ability, which are essential for persuading farmers to adopt unfamiliar technologies. Well-designed training goes beyond theoretical content to include participatory methods, demonstrations, and field experiences that reflect actual farming conditions. Continuous learning opportunities help extension workers stay informed about innovations such as digital agriculture, integrated pest management, and climate-smart practices. In this sense, training functions not only as a technical exercise but also as an investment in human capital, fostering professional growth and a sense of responsibility among field officers.

Equally important is the work environment in which extension officers perform their duties. A supportive environment provides the resources, infrastructure, and motivation necessary for effective service delivery. Access to transportation, communication tools, and well-organized administrative support allows officers to reach farmers more regularly and efficiently. At the same time, positive interpersonal relationships, recognition for good performance, and fair supervision contribute to a sense of belonging and professional pride. When extension officers operate in an enabling environment, they are more likely to maintain commitment, creativity, and accountability in their work. Conversely, a poor or unsupportive environment—marked by inadequate facilities, limited funding, and unclear job roles—often results in frustration, absenteeism, and low productivity. Therefore, both training and the work environment must be addressed simultaneously to achieve sustainable improvements in extension performance.

Despite their acknowledged importance, the effectiveness of agricultural extension systems in many developing countries, including Indonesia, continues to fall short of expectations. In several regions, extension workers encounter chronic challenges such as insufficient budgets for field visits, a lack of transportation, poor access to up-to-date information, and limited opportunities for professional development. Many work in geographically remote and socioeconomically disadvantaged areas, where the logistical barriers are severe and institutional support is weak. Under such conditions, it becomes difficult to maintain regular contact with farmers, let alone deliver comprehensive technical guidance. Moreover, the training provided to extension officers often emphasizes administrative procedures or general agricultural concepts rather than practical, problem-oriented learning. As a result, many field officers feel ill-equipped to handle the complex realities of smallholder agriculture, especially in the face of climate variability, market fluctuations, and technological change.

Empirical evidence from multiple contexts supports the idea that training and work environment jointly shape employee performance across sectors. Training enhances the technical competence and adaptability of workers, while conducive work environments improve morale, satisfaction, and long-term engagement. Within agricultural extension, these two elements are closely intertwined. For instance, an officer who has received strong technical training but lacks transportation or office facilities may still struggle to assist farmers effectively. Conversely, an officer with a supportive workplace but outdated skills may fail to provide relevant advice. Therefore, the synergy between training

and work environment is what ultimately determines the quality of service delivery and the rate at which innovations are adopted by farmers.

In Indonesia, the agricultural extension system has undergone several reforms intended to strengthen institutional capacity and improve service delivery. The government has introduced programs focused on human resource development, farmer empowerment, and technology transfer. Yet, the outcomes of these efforts remain mixed. While some districts have achieved notable success in improving agricultural productivity, others continue to face stagnation due to gaps in training quality, resource allocation, and coordination between agencies. The performance of extension officers varies widely across provinces, reflecting differences in infrastructure, funding, and management support. In some regions, extension agents receive regular training and have access to digital tools and vehicles, while in others, they work with minimal resources and outdated equipment. Understanding these disparities is essential to formulating more effective and equitable extension policies.

The **Rajagaluh District** of Majalengka Regency in West Java presents a representative case for exploring these dynamics. The local economy relies heavily on rice cultivation, making the effectiveness of extension programs a key determinant of both household income and regional food supply. Extension officers in Rajagaluh are engaged in a variety of training programs organized by the Ministry of Agriculture, regional offices, and local institutions. However, the quality and frequency of these programs vary, as do the working conditions under which officers operate. Some enjoy relatively supportive environments with adequate facilities, while others struggle with limited budgets, transportation difficulties, and inconsistent administrative backing. These variations create a valuable opportunity to assess how training and workplace factors combine to influence both worker performance and farm-level productivity outcomes.

Despite several studies on agricultural extension in Indonesia, there remains limited empirical evidence that links the human resource aspects of extension—specifically training and work environment—to measurable outcomes in crop productivity. Most existing studies focus either on evaluating training effectiveness or assessing general job satisfaction among extension workers, without examining how these factors jointly contribute to agricultural outputs. Furthermore, while policy documents emphasize capacity building as a strategy for improving agricultural performance, few studies have quantitatively tested these assumptions using field-level data. This research therefore aims to fill that gap by analyzing how the quality of training and the nature of the work environment affect the performance of extension officers and, in turn, influence rice productivity in Rajagaluh District.

In this context, the present study sets out to achieve two main objectives. First, it seeks to examine the individual and combined effects of training and work environment on the performance of agricultural extension workers. Second, it aims to evaluate how improvements in these factors translate into higher rice yields and more sustainable agricultural outcomes. By addressing these objectives, the research contributes to a deeper understanding of the mechanisms that link institutional support, human capital development, and agricultural productivity. The findings are expected to offer practical insights for policymakers and agricultural institutions seeking to enhance the effectiveness of extension services, not only in Rajagaluh but also in other regions facing similar challenges.

2. Literature Review

2.1 Training and Human Resource Development in Agriculture

Training remains one of the most powerful instruments for strengthening human resource capacity within the agricultural sector. It enables extension personnel to update their technical knowledge, refine communication abilities, and build the confidence needed to guide farmers effectively in dynamic field situations (Ali et al., 2023). Well-structured programs help officers interpret new research, translate scientific results into practice, and accompany farmers through the process of adopting improved technologies (Raji et al., 2024). In an era of climate uncertainty, fluctuating markets, and rapid technological change, ongoing professional learning ensures that extension workers remain adaptive and forward-looking (Nedumaran & Ravi, 2019; Kalogiannidis & Syndoukas, 2024).

Beyond technical competence, training serves to strengthen the connection between research institutions and the communities they aim to serve. Through experiential exercises, participants learn diagnostic and analytical skills that allow them to identify production problems and suggest locally feasible solutions (Makinde, 2024). It also cultivates professional motivation and a sense of efficacy—qualities repeatedly associated with high-quality service delivery (Ayanwale et al., 2023). Evidence from human-resource studies demonstrates that employees who receive targeted and relevant training achieve higher productivity and stronger commitment to their organizations (Ichdan,

2024). In the extension context, this leads to clearer communication with farmers, faster adoption of innovations, and more durable productivity gains (Listiana et al., 2023).

Yet, in many developing economies, training programs still lean heavily toward classroom instruction and theoretical content (Anang et al., 2020). Limited opportunities for field practice or participatory learning reduce their practical value. To close this gap, current thinking encourages greater emphasis on experiential and problem-based learning, demonstration plots, and the use of digital platforms that allow real-time information exchange (Mulungu et al., 2025). Combining traditional workshops with interactive digital tools can significantly improve both the quality and the reach of training, fostering innovation and wider diffusion of knowledge among farming populations.

From a theoretical perspective, these ideas are rooted in **Human Capital Theory**, which argues that investments in people's knowledge and skills yield measurable returns in productivity and efficiency (Kalogiannidis & Syndoukas, 2024). Each training activity, therefore, represents an investment in human capital that equips extension workers with the competencies required to advance rural development and technological transformation in agriculture.

2.2 Work Environment and Employee Motivation

The work environment comprises the physical conditions and social relationships under which individuals perform their jobs. It includes infrastructure, equipment, transportation facilities, leadership approach, and collegial interaction (Napitupulu et al., 2021). Within agricultural extension, the environment is a decisive factor shaping motivation, job satisfaction, and ultimately performance (Kartini & Nurhidayati, 2023). A well-organized environment supports operational efficiency and protects the psychological well-being of staff (Nyarko & Kozári, 2021).

When extension officers have the resources and support they need, both their physical and emotional needs are met. Adequate logistical arrangements enable them to reach remote farming areas, while reliable communication systems guarantee that information and feedback circulate quickly (Birke et al., 2019). Constructive supervision and recognition for good performance create a sense of belonging and professional pride (Latif et al., 2022). Workers who feel valued generally show stronger engagement and deliver higher-quality services (Nuryanti et al., 2021).

By contrast, a lack of facilities, unclear job descriptions, or limited opportunities for advancement often leads to declining morale and performance (Jones et al., 2023). Many field officers still struggle with inadequate transportation and insufficient budgets, which restrict their ability to make farm visits and provide timely assistance (Baloch & Thapa, 2019). Such barriers slow technology diffusion and weaken innovation adoption at the farm level.

The link between workplace conditions and motivation can be explained through **Herzberg's Motivation–Hygiene Theory**. According to this model, improving hygiene factors—such as policies, physical facilities, and administrative support—reduces dissatisfaction, while strengthening motivators like recognition and responsibility enhances performance (Herzberg, 1966, as interpreted by Ichdan, 2024). In the extension system, combining adequate facilities with clear incentives and institutional encouragement produces a motivated workforce and more reliable service delivery (Osei et al., 2023). Thus, a supportive environment, reinforced by effective training, forms the backbone of continuous innovation and productivity growth in agriculture.

2.3 Performance of Agricultural Extension Workers

Performance refers to how effectively extension officers accomplish their responsibilities and contribute to institutional and community objectives (Siraj & Hågen, 2023). It encompasses both quantitative measures—such as the number of farmer contacts, training sessions, or adoption rates—and qualitative aspects like professionalism, communication skill, and problem-solving ability (Nuryanti et al., 2021).

Several conceptual approaches have been developed to evaluate performance. The **competency-based model** highlights technical expertise, communication proficiency, and ethical behavior as core components (Rinofi et al., 2021). The **results-based model** links effectiveness to tangible outputs such as yield increases and income improvements (Listyanto et al., 2023). A third, **behavioral model**, stresses attitudes, initiative, and work discipline (Kartini & Nurhidayati, 2023). Although these models differ in focus, they converge on the notion that performance is strongly influenced by organizational factors—leadership, supervision, resource availability, and reward systems (Kalogiannidis & Syndoukas, 2024).

High-performing extension officers combine technical mastery with empathy and adaptability in their interactions with farmers (Bourne et al., 2021). Their achievements are most visible when training, workplace support, and personal motivation align (Napitupulu et al., 2021). Under these circumstances, officers strengthen relationships

with farming communities, provide timely and relevant recommendations, and stimulate innovation—outcomes that directly translate into higher productivity and improved rural welfare.

2.4 Relationship Between Extension Performance and Rice Productivity

Rice production remains central to Indonesia’s strategy for food security and rural development (Adrian et al., 2022). Although physical resources such as soil fertility and irrigation influence yields, human resources—particularly extension personnel—often determine whether new technologies are adopted effectively (Tong et al., 2023). Extension officers act as the vital connection between scientific knowledge and practical farming solutions (Maake & Antwi, 2022).

Empirical studies consistently demonstrate that well-functioning extension systems boost rice productivity and farmer income (Alam et al., 2024). Regular contact between officers and farmers, combined with targeted training, enhances farmers’ understanding of improved seed varieties, integrated pest management, and efficient water use (Sarku et al., 2024). Conversely, weak extension performance—manifested in infrequent field visits or outdated recommendations—slows technology diffusion and limits yield growth (Baloch & Thapa, 2019). In Indonesia, programs that combine intensive training with motivational support have led to faster adoption of modern practices and measurable improvements in rice production (Listiana et al., 2023). By acting as catalysts for innovation, extension officers promote environmentally sound farming and more efficient resource management (Liu et al., 2020). Strengthening their performance through continuous capacity development is therefore essential for achieving national goals of food self-sufficiency and inclusive growth.

2.5 Conceptual Framework and Hypotheses

Drawing upon the reviewed literature, this study proposes a framework that connects **training** and **work environment** to **extension performance**, which subsequently influences **rice productivity**. In this framework, training and work environment serve as independent variables, performance functions as a mediating variable, and productivity represents the final outcome (Raji et al., 2024).

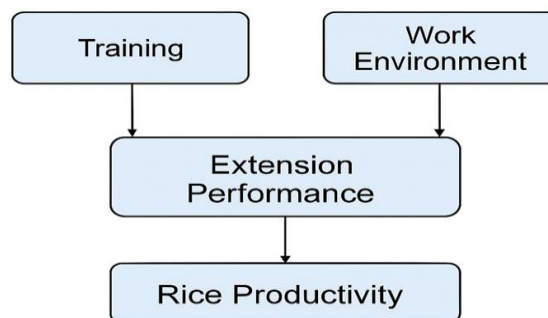


Figure 1. Conceptual Framework of the Study: Relationship Between Training, Work Environment, Extension Performance, and Rice Productivity.

The framework illustrates that improvements in human resource development and workplace conditions together generate the capacity and motivation required for higher productivity. It integrates insights from **Human Capital Theory**—emphasizing skill investment—and **Motivation–Hygiene Theory**, which focuses on psychological satisfaction and motivation (Herzberg, 1966). Together, these perspectives suggest that technical competence and intrinsic motivation operate as complementary forces that enhance job performance.

Accordingly, the study formulates three hypotheses:

- **H₁:** Training exerts a positive and significant effect on the performance of agricultural extension workers.
- **H₂:** Work environment exerts a positive and significant effect on the performance of agricultural extension workers.
- **H₃:** Training and work environment jointly improve extension performance and contribute to higher rice productivity.

In practical terms, the model assumes that extension officers who receive adequate, needs-based training and operate in supportive environments display greater confidence, efficiency, and motivation. Their enhanced

performance facilitates better communication with farmers, faster transfer of agricultural technologies, and broader adoption of innovations. Ultimately, this chain of effects leads to measurable productivity gains at the farm level and supports long-term food security and rural development objectives in Indonesia.

3. Materials and Methods

3.1 Research Area and Design

This research was carried out in **Rajagaluh District**, Majalengka Regency, West Java, Indonesia. Geographically, the district lies between 6°48' south latitude and 108°21' east longitude and covers an area of approximately 73 square kilometers. Most of the land consists of irrigated lowland paddy fields, with water supplied by the Cimanuk irrigation system. The region experiences an average annual rainfall of about 2,000 millimeters, which supports two to three rice-growing seasons each year. These favorable climatic and hydrological conditions, along with consistent local government initiatives to achieve rice self-sufficiency, make Rajagaluh an ideal setting for studying the relationship between training, work environment, and the performance of agricultural extension officers. Local extension activities in this area are coordinated by the Agricultural Extension Center (*Balai Penyuluhan Pertanian* – BPP Rajagaluh), which operates under the Majalengka Food Security and Agriculture Office.

A **quantitative descriptive–verificative research design** was used in this study. The descriptive component aimed to portray the demographic and professional characteristics of the respondents, while the verificative component tested the statistical relationships among training, work environment, and performance. This design allowed the study not only to describe observed phenomena but also to verify causal relationships and validate the conceptual framework empirically. By combining descriptive and explanatory approaches, the study provided a comprehensive understanding of how human resource factors influence extension effectiveness and, ultimately, rice productivity in the study area.

3.2 Population and Sampling

The research population included **all 52 agricultural extension officers** assigned to BPP Rajagaluh who had participated in formal agricultural training programs during 2023–2024. Because the total number of officers was relatively small and manageable, a **census (saturated) sampling technique** was employed, including every eligible respondent in the study rather than selecting a random subset. This approach ensured complete coverage of the population, minimized sampling bias, and allowed for greater accuracy in representing the characteristics and experiences of extension workers in the district.

Each respondent met specific inclusion criteria: a minimum of one year of active field experience and documented attendance at at least one formal or informal agricultural training activity. By incorporating the entire population, the research achieved a holistic representation of the workforce's training exposure, working conditions, and job performance. This comprehensive sampling approach enhanced the reliability of statistical analysis and the validity of findings drawn from the population.

3.3 Data Collection

Data collection was conducted between January and March 2025 and relied on both primary and secondary sources to ensure triangulation and validity of information.

Primary data were collected using structured questionnaires complemented by semi-structured interviews. The questionnaire was divided into five sections: (1) demographic and professional information, (2) training participation and quality, (3) assessment of workplace conditions, (4) self-evaluation of performance, and (5) open-ended comments for additional insights. Most questionnaire items used a five-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”).

To deepen understanding of contextual issues, semi-structured interviews were conducted with ten selected respondents, including senior supervisors. These discussions explored topics such as logistical challenges, institutional support mechanisms, and motivational factors that influence field performance. Qualitative insights obtained from these interviews enriched the interpretation of quantitative findings.

Secondary data were drawn from the official records of the Majalengka Food Security and Agriculture Office (*Dinas Ketahanan Pangan dan Pertanian Kabupaten Majalengka*). Documents reviewed included annual extension performance reports, regional agricultural statistics, and rice yield data for 2022 and 2023. The use of these records

enabled comparison of productivity levels before and after the most recent training and workplace interventions, serving as a validation for observed performance changes among extension officers.

All participants received a full explanation of the study's objectives and procedures before taking part. Written informed consent was obtained from each respondent, and confidentiality was guaranteed for all collected information. Ethical approval was granted by the university's Institutional Review Board (Approval No. AGR-E/2025-014).

3.4 Variables and Model Specification

This study analyzed three core variables: **training (X₁)**, **work environment (X₂)**, and **extension worker performance (Y)**. Rice productivity served as a contextual variable used to validate whether improvements in performance were reflected in farm-level outcomes.

- **Training (X₁)** was measured using four indicators: frequency of training participation, relevance of training content to extension duties, competence of trainers or facilitators, and applicability of the training to field operations.
- **Work Environment (X₂)** was evaluated through indicators covering infrastructure adequacy, administrative and supervisory support, teamwork and communication, and physical safety in field conditions.
- **Extension Worker Performance (Y)** was assessed using indicators such as communication effectiveness, quality of technical advice provided to farmers, farmer participation in extension activities, and rates of innovation adoption among target groups.

Each variable underwent a reliability assessment, with all constructs showing **Cronbach's alpha values above 0.80**, indicating strong internal consistency.

The relationship between these variables was analyzed using the following **multiple linear regression model**:

$$Y = a + b_1X_1 + b_2X_2 + e$$

Where:

Y = performance score of agricultural extension workers

X_1 = training index

X_2 = work environment index

a = constant

b_1, b_2 = regression coefficients e = error term

Both b_1 and b_2 were expected to be positive, suggesting that improved training and favorable working conditions would enhance extension performance. Additionally, a paired-sample t-test was applied to compare mean rice yields for 2022 and 2023, aiming to determine whether observed changes in productivity aligned with improvements in training and workplace conditions.

3.5 Data Analysis Techniques

Quantitative analysis was conducted using IBM SPSS Statistics (Version 25). Prior to analysis, data were screened for missing values, inconsistencies, and outliers. The assumptions of normality and linearity were verified using descriptive statistics and residual plots. Descriptive analysis (means, standard deviations, and frequency distributions) was used to summarize respondent characteristics and variable patterns.

To test the study hypotheses, multiple linear regression analysis was applied to evaluate both the joint and individual effects of training and work environment on performance. The coefficient of determination (R^2) measured how much variation in extension performance was explained by the two predictors. An F-test assessed the overall model significance, while t-tests determined the contribution of each independent variable at a significance level of $\alpha = 0.05$.

Diagnostic tests confirmed that regression assumptions were met. Normality of residuals was verified using histogram and Kolmogorov–Smirnov tests, while Variance Inflation Factor (VIF) values below 5 indicated the absence of multicollinearity. The residual plots also confirmed homoscedastic variance, supporting the suitability of the regression model.

To evaluate the link between performance improvement and farm outcomes, a paired-sample t-test was conducted to compare rice yield data from 2022 and 2023. A statistically significant result ($p < 0.05$) indicated that productivity gains were associated with the combined influence of enhanced training and better working conditions.

Complementing the quantitative analysis, qualitative data from interviews were examined through thematic analysis. Recurring themes such as institutional barriers, access to resources, motivation, and supervisory support were identified. Integrating these qualitative insights with statistical results provided a holistic understanding of the mechanisms connecting training, work environment, and extension performance. This mixed-methods approach strengthened the validity of the findings and grounded the analysis within the local realities of agricultural extension in Rajagaluh District.

Results and Discussion

4. Results

4.1 Profile of Agricultural Extension Workers

The descriptive results provide an overall picture of the 52 agricultural extension officers who participated in the study in Rajagaluh District. Their demographic and professional characteristics indicate a balanced workforce with a diverse yet cohesive composition, suggesting that the district's extension system is sustained by capable personnel representing a range of ages, experiences, and qualifications.

In terms of age distribution, nearly half of the respondents (48%) were between 35 and 44 years old, 32% were in the 45–54 age group, and the remaining 20% were younger than 35. This structure reflects a predominantly mid-career workforce—an age range often considered the most productive and adaptable for professional performance. Officers in this category combine years of field experience with the flexibility to adopt new methods and technologies. The pattern also implies the presence of an optimal mix between seasoned practitioners and younger officers who bring fresh perspectives and openness to innovation.

Educational attainment among respondents was notably high. Approximately 73% held bachelor's degrees in agriculture or closely related fields, 15% had associate diplomas, and 12% possessed postgraduate (master's) degrees. The predominance of tertiary-level education underscores ongoing government efforts to professionalize the extension service. Such academic preparation is essential for understanding and communicating modern agricultural technologies, analytical tools, and sustainable management practices. The findings reinforce the principles of **Human Capital Theory**, which highlights that education and skill acquisition directly enhance worker productivity and the overall effectiveness of extension systems.

Professional experience varied but was generally extensive. Nearly half of the officers (46%) had served between six and ten years, 30% had been in service for eleven to fifteen years, and 24% had worked for more than fifteen years. This distribution points to a stable and experienced cadre with the potential for peer learning and mentorship. Experienced officers contribute institutional memory and continuity, while newer staff ensure the introduction of updated knowledge and techniques. Such a combination supports the steady delivery of extension services and helps maintain quality and consistency across programs.

Training engagement among officers was high. Almost all respondents had participated in multiple training activities, with 62% reporting attendance at more than twenty sessions in the past five years. The content of these programs ranged from sustainable rice production and integrated pest management to the use of digital technologies in agricultural advisory services. This active participation demonstrates strong institutional support for continuous professional development and highlights the government's commitment to maintaining a skilled extension workforce. However, qualitative feedback obtained during interviews revealed variability in the quality of training and the absence of systematic post-training assessments. Several respondents noted that while opportunities were frequent, some sessions lacked practical relevance or sufficient follow-up evaluation. These observations suggest a need for more targeted, participatory, and results-oriented training strategies that directly address field challenges.

Taken together, the demographic and professional characteristics of the Rajagaluh extension officers depict a workforce that is both experienced and educationally equipped to support the modernization of local agriculture. The combination of advanced qualifications, long-term field experience, and regular participation in training provides a solid human resource base for extension services in the district. These attributes establish a strong foundation for analyzing how human capital factors—specifically training and work environment—interact to influence job performance and agricultural productivity outcomes.

4.2 Impact of Training and Work Environment on Performance

4.2.1 Model Summary and Goodness of Fit

Multiple linear regression was conducted to test the influence of training (X_1) and work environment (X_2) on extension worker performance (Y). The results are summarized in **Table 1**.

Table 1. Model Summary

Model	R	R ²	Adjusted R ²	Std. Error
1	0.750	0.562	0.546	3.176

The regression model indicated that **training and work environment together accounted for 56.2% of the variance in extension worker performance** ($R^2 = 0.562$). After adjusting for sampling variation, the **adjusted R² value of 0.546** suggests that more than half of the differences in performance among respondents can be explained by these two factors. The remaining 43.8% of variation likely arises from other influences not included in the model, such as motivation, quality of supervision, organizational incentives, or resource distribution.

This proportion of explained variance is relatively strong for behavioral and social science research, where outcomes are often affected by complex contextual and institutional dynamics. The result reinforces the theoretical proposition that **investments in skill development and supportive working environments function synergistically to enhance professional effectiveness**, aligning with the core premise of **Human Capital Theory**, which emphasizes that continuous investment in human resources leads to measurable improvements in productivity and performance.

4.2.2 Analysis of Variance (F-Test)

The **F-test** was applied to examine the joint significance of both independent variables. Results are presented in **Table 2**.

Table 2. ANOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig. (p)
Regression	182.51	2	91.25	6.412	0.016*
Residual	142.13	49	2.90		
Total	324.64	51			

*Significant at $\alpha = 0.05$

The F-value of **6.412** with a **p-value of 0.016** (<0.05) indicates that the model is statistically significant. This means training and work environment, when considered jointly, significantly influence the performance of extension workers. The significance of this combined relationship implies that skill development is more effective when supported by appropriate institutional structures and working conditions.

4.2.3 Regression Coefficients (t-Test Results)

Individual effects of the predictors were examined using t-tests. The results are summarized in Table 3.

Table 3. Regression Coefficients

Predictor	Unstandardized Coefficients (B)	Std. Error	t	Sig. (p)
(Constant)	-0.668	2.018	-0.331	0.748
Training (X_1)	0.109	0.171	0.637	0.539
Work Environment (X_2)	0.585	0.291	2.015	0.072

The regression equation derived from these findings is:

$$Y = -0.668 + 0.109X_1 + 0.585X_2 + e$$

Although both coefficients were positive, indicating that better training and improved work environments enhance performance, neither variable was statistically significant at $\alpha = 0.05$. Training ($p = 0.539$) and work environment ($p = 0.072$) individually did not reach the threshold for significance. The results suggest that while both factors are positively correlated with performance, their independent effects are insufficient without complementary support from other institutional factors such as incentives, monitoring, and job recognition.

4.2.4 Interpretation and Theoretical Integration

The results provide clear support for **Hypothesis 3 (H₃)**, confirming that training and work environment together exert a significant influence on the performance of agricultural extension officers. In contrast, the lack of independent significance for **Hypotheses 1 (H₁)** and **2 (H₂)** suggests that interventions implemented in isolation—such as training without complementary workplace support, or improvements in facilities without adequate motivation—produce limited effects.

This pattern aligns closely with **Herzberg’s Motivation–Hygiene Theory**, which asserts that optimal employee performance occurs only when both intrinsic motivators—such as achievement, recognition, and professional responsibility—and extrinsic hygiene factors—such as policies, supervision, and physical working conditions—are addressed simultaneously. Within the context of Rajagaluh, frequent training sessions appear to improve technical competence, yet their long-term impact is constrained when supervision, incentives, and logistical support are insufficient.

The findings are consistent with earlier empirical evidence showing that training yields stronger outcomes when accompanied by a supportive organizational environment and effective institutional follow-up mechanisms (Napitupulu et al., 2021; Ichdan, 2024). The positive regression coefficients for both predictors further reinforce this conclusion, indicating that enhancements in either dimension contribute to improved performance. Together, these results reaffirm the theoretical argument that **human resource development and workplace quality function as interdependent components** in driving employee efficiency and sustaining professional effectiveness.

4.3 Effect of Training and Motivation on Rice Productivity

To evaluate whether improvements in extension worker performance were reflected in tangible agricultural outcomes, a **paired-sample t-test** was conducted to compare mean rice yields between 2022 and 2023 (Table 4).

Table 4. Paired-Sample t-Test for Rice Productivity

Year	Mean Yield (tons/ha)	Std. Deviation	t	df	Sig. (2-tailed)
2022	5.62	0.74			
2023	6.08	0.69	-13.266	12	0.000*
*Significant at $\alpha = 0.05$					

The results revealed a **significant increase in rice yields**, rising from an average of 5.62 tons per hectare in 2022 to 6.08 tons per hectare in 2023—an overall gain of approximately **8.2%**. The calculated t -value of -13.266 with a p -value of 0.000 (<0.05) indicates that the improvement was statistically significant and unlikely due to random variation.

This upward trend in productivity aligns closely with the reported enhancement in extension worker performance. The evidence suggests that officers who received more relevant training and operated within improved working conditions were better able to translate technical knowledge into practical guidance for farmers. Stronger coordination between training programs and field implementation likely facilitated greater adoption of improved seed varieties, better irrigation management, and more efficient pest control practices.

Viewed through the lens of **Human Capital Theory**, these findings illustrate the broader economic and social benefits of investing in human resources. When training strengthens competence and a supportive work environment reinforces motivation and continuity, measurable improvements occur not only in employee output but also in farm-level productivity and community welfare. In this sense, human resource development within agricultural extension

serves as both a professional and a developmental investment, producing returns that extend beyond individual performance indicators.

Qualitative evidence obtained from interviews further substantiated these quantitative results. Farmers reported higher satisfaction with extension services, citing more frequent visits, practical demonstrations, and improved advice on harvesting and post-harvest handling. Many noted that officers were more approachable and responsive to local needs than in previous years. These observations reinforce the statistical evidence and demonstrate the practical impact of strengthening both training and workplace systems within the extension network. Collectively, the findings confirm that a well-trained and adequately supported extension workforce is a crucial driver of improved rice productivity and sustainable agricultural performance in Rajagaluh District.

4.4 Summary of Key Findings

The empirical results of this study highlight several important insights into the relationship between training, work environment, and agricultural extension performance in Rajagaluh District. The descriptive findings reveal that the district's extension workforce is primarily composed of mid-career officers who are well-educated, professionally experienced, and actively engaged in continuous training. This profile reflects a mature and competent human resource base that provides a strong foundation for sustaining effective extension services.

The regression analysis demonstrated that **training and work environment together explain 56.2% of the variation in extension worker performance**, confirming that the interaction between skill enhancement and conducive workplace conditions significantly improves professional outcomes. This finding validates the interdependence between human capital investment and institutional support, showing that performance gains are achieved most effectively when both factors are developed in tandem.

Individually, however, the effects of training and work environment were positive but statistically insignificant, suggesting that neither dimension alone is sufficient to drive substantial improvement. This outcome reinforces **Herzberg's Motivation–Hygiene Theory**, which proposes that motivation and environmental factors must coexist to sustain high performance. In this context, training can enhance technical competence, but without adequate supervision, incentives, and resources, its potential impact remains limited.

The productivity analysis further revealed a **statistically significant increase in rice yields** from 5.62 tons per hectare in 2022 to 6.08 tons per hectare in 2023 ($p < 0.05$). This improvement demonstrates that better-trained and well-supported extension officers contribute directly to tangible agricultural outcomes. The link between enhanced worker performance and improved farm productivity underscores the practical relevance of human resource development within agricultural institutions.

Overall, the findings are consistent with both **Human Capital Theory** and **Motivation–Hygiene Theory**, emphasizing that capacity building and conducive work environments jointly determine the efficiency and effectiveness of agricultural extension systems. The results confirm that investment in human capital, when supported by favorable institutional structures, produces measurable benefits for both personnel performance and agricultural productivity, thereby contributing to the broader goals of sustainable rural development and food security.

5. Discussion

5.1 Interpretation of Key Findings

This study investigated the interplay between training, work environment, and the performance of agricultural extension officers in Rajagaluh District, as well as the extent to which these human resource factors influence rice productivity. The results indicated that training and work environment jointly exerted a significant effect on performance, explaining more than 56% of the observed variation, even though neither factor showed a statistically significant effect when analyzed separately. Moreover, the significant increase in rice yield between 2022 and 2023 confirmed that improvements in extension performance were closely associated with higher agricultural productivity at the community level.

These findings underscore that the combined influence of capacity development and supportive workplace conditions is more consequential than the independent contribution of either factor. In professions centered on knowledge dissemination and advisory services, performance is inherently multidimensional—shaped not only by technical competencies gained through training but also by organizational contexts that facilitate or limit their practical application. The results are consistent with Human Capital Theory, which emphasizes that investments in knowledge and skill development enhance productivity, and with Motivation–Hygiene Theory, which stresses that the work

environment plays a crucial role in sustaining satisfaction, motivation, and long-term performance stability. Together, these theoretical perspectives provide a coherent explanation of how training and environmental support interact to strengthen extension effectiveness and promote sustainable gains in agricultural productivity.

5.2 Integration with Previous Research

The joint influence of training and work environment identified in this study aligns closely with earlier research that underscores the synergy between individual competence and institutional support. Previous studies have demonstrated that training enhances employees' technical capacity and adaptability but yields its greatest benefits when accompanied by enabling conditions such as adequate facilities, effective leadership, and supportive supervision. The present findings reaffirm this principle, showing that training initiatives contribute to improved performance only when extension workers have access to the necessary resources, autonomy, and motivation to apply newly acquired skills in the field.

The lack of statistical significance for training as an independent variable appears to stem from the qualitative aspects of the training programs rather than their frequency. Although participation rates were high, many respondents reported repetitive content and insufficient opportunities for experiential or field-based learning. These limitations may have weakened the transfer of knowledge into practical performance outcomes. This interpretation echoes previous observations that the long-term effectiveness of training diminishes in the absence of systematic follow-up, performance monitoring, or incentive mechanisms that reinforce behavioral change and skill application.

Similarly, the non-significant independent effect of the work environment may reflect disparities in resource allocation and managerial practices among extension units. While most officers operated from adequately equipped offices, qualitative evidence indicated that restricted mobility and limited operational budgets curtailed the frequency of field visits and on-site assistance. These findings are consistent with prior arguments suggesting that improvements in the physical and administrative environment must be accompanied by effective supervision, recognition, and participatory management to sustain higher levels of performance.

Taken together, the combined significance of training and work environment demonstrates that these factors operate as **interdependent components** rather than as separate determinants of performance. This interaction reflects the **systems approach to performance management**, which posits that outcomes are shaped by the integration of multiple, mutually reinforcing subsystems. In this context, the agricultural extension system performs most effectively when investments in technical capacity are complemented by organizational structures, logistical resources, and motivational incentives that enable workers to apply their skills productively and consistently in the field.

5.3 Theoretical Explanation

The findings of this study offer empirical validation for both **Human Capital Theory** and **Motivation–Hygiene Theory** as complementary frameworks for understanding extension performance. From a **Human Capital** perspective, training functions as a strategic investment in human resources that strengthens professional competence, efficiency, and innovative capacity. Extension officers who participate in regular training acquire updated technical knowledge and problem-solving abilities, enabling them to address complex challenges in diverse field conditions. However, as **Motivation–Hygiene Theory** emphasizes, technical proficiency alone is not sufficient to sustain high performance; an enabling environment characterized by supportive leadership, recognition, and constructive interpersonal relations is equally essential for maintaining motivation and engagement over time.

The integration of these two dimensions—capacity development and workplace support—creates a mutually reinforcing dynamic between competence and motivation. When training is accompanied by a supportive work environment, the two forces interact synergistically, producing greater improvements in performance than either could achieve independently. This interdependence helps explain why training and work environment collectively showed significant effects on extension performance, even though each variable, when examined separately, was statistically insignificant. In other words, the effectiveness of one factor depends on the strength of the other, illustrating the complementary nature of intrinsic and extrinsic drivers of performance.

The results also highlight the mediating role of organizational conditions in realizing the potential benefits of human capital investment. Without adequate facilities, logistical resources, and supervisory encouragement, the gains from training may remain theoretical rather than practical. Conversely, a favorable work environment that lacks ongoing knowledge renewal can foster stagnation and limit innovation. Therefore, maintaining a balance between continuous skill enhancement and a supportive institutional context is crucial for sustaining high-quality extension services and driving productivity improvements. The study thus reaffirms that the long-term success of agricultural

extension depends not only on the technical capabilities of individual officers but also on the organizational systems that enable them to perform effectively and deliver meaningful outcomes for farming communities.

5.4 Mechanisms Linking Performance and Rice Productivity

The marked improvement in rice yields between 2022 and 2023 provides clear evidence that well-trained and adequately supported extension officers play a direct role in enhancing farm-level outcomes. Several mechanisms explain this connection. First, skilled extension workers possess the analytical and communication abilities required to translate agricultural innovations into practical guidance, enabling farmers to adopt improved practices that increase efficiency and reduce production risks. Second, a supportive work environment—characterized by access to resources, reliable transportation, and effective coordination—encourages officers to conduct regular field visits, organize demonstrations, and maintain close monitoring of farmers' progress. This sustained engagement ensures that technologies introduced during training are effectively disseminated and applied in the field.

In Rajagaluh, the rise in productivity can be attributed to the combined effect of these complementary factors. Extension officers who received intensive training on climate-resilient rice varieties, integrated pest management, and soil fertility maintenance were able to provide relevant and timely technical assistance to local farmers, resulting in higher rates of technology adoption. At the same time, improvements in communication systems and logistical support expanded the reach and efficiency of extension services, allowing officers to engage a larger number of farming households. The integration of enhanced human capital and supportive institutional conditions thus created a positive feedback loop between knowledge dissemination and agricultural outcomes.

This relationship reinforces the broader principle that extension performance functions as a critical intermediary between institutional investment and farm-level productivity. Competent and motivated extension workers serve as vital conduits for innovation, bridging the gap between research outputs and community-based agricultural practices. Through their dual roles as educators and facilitators, they ensure that government programs and development initiatives are translated into tangible results at the grassroots level. In this way, the synergy between technical training and enabling work environments not only improves individual performance but also strengthens the overall capacity of the agricultural extension system to drive sustainable productivity growth.

5.5 Comparison with Other Studies

The findings of this study are consistent with a wide body of empirical research on agricultural extension systems in developing countries. Previous studies have shown that the combination of training and favorable working conditions explains a substantial portion of performance variation among extension personnel. In several regional contexts, improvements in technical training—when supported by adequate logistics, supervision, and institutional backing—have been associated with greater adoption of recommended technologies and significant increases in crop yields. Conversely, research has also demonstrated that the effects of training alone tend to be modest when not accompanied by enabling conditions such as access to resources, operational autonomy, and systematic follow-up mechanisms.

The pattern observed in Rajagaluh mirrors these trends. While training remains essential for enhancing technical competence and knowledge transfer, its impact on performance becomes most evident when complemented by strong organizational and environmental support systems. This study contributes to the broader literature by providing empirical evidence from Indonesia, reinforcing the notion that integrated approaches—combining capacity development with institutional strengthening—are universally relevant across diverse agricultural systems. The results suggest that policies focusing solely on individual skill enhancement may have limited effect unless accompanied by improvements in the structural and managerial environment that governs daily extension work.

Furthermore, the significant relationship found between extension performance and rice productivity resonates with global findings that link motivated and capable extension officers to higher technology diffusion, improved resource efficiency, and more sustainable farming practices. These outcomes underscore the strategic role of **human resource management** in advancing agricultural development and achieving long-term food security objectives. By confirming the synergy between human capital investment and supportive institutional contexts, this study reinforces the argument that the success of agricultural transformation depends as much on the quality of extension personnel as on the systems and environments that enable them to perform effectively.

5.6 Policy and Practical Implications

The results of this study highlight several important **policy and managerial implications** for strengthening the agricultural extension system. First, **training programs should be restructured** to prioritize field-based, experiential, and participatory learning rather than traditional classroom approaches. Continuous professional development initiatives that integrate practical problem-solving, peer-to-peer learning, and the use of digital extension tools are likely to produce more meaningful and lasting improvements in worker competence. These approaches help bridge the gap between theory and practice, ensuring that training outcomes translate directly into field performance.

Second, **enhancing the work environment** is essential for sustaining motivation and ensuring consistent service delivery. Targeted investments in transportation facilities, communication technologies, and safe working conditions are necessary to support efficient field operations. Equally important are institutional mechanisms that promote job satisfaction—such as performance-based incentives, opportunities for career advancement, and constructive supervision. These factors can strengthen accountability and foster a sense of professional pride among extension officers, leading to improved morale and productivity.

Third, the **integration of information and communication technology (ICT)** into extension delivery should be accelerated. The adoption of mobile advisory platforms, online training modules, and digital feedback systems can expand outreach, facilitate real-time communication with farmers, and enhance data-driven decision-making. ICT tools also create opportunities for two-way interaction, enabling extension workers to tailor advice to specific local conditions and receive immediate feedback on program effectiveness.

Finally, **monitoring and evaluation systems** must be reinforced to assess the outcomes of both training and workplace interventions. Regular performance reviews, coupled with feedback from farmers and other stakeholders, can provide valuable insights for policy refinement and future program design. Establishing measurable indicators—such as adoption rates, yield improvements, and satisfaction scores—will allow institutions to track progress more systematically. By institutionalizing evidence-based assessment, decision-makers can ensure that investments in human resource development translate into tangible, sustainable gains in agricultural productivity and rural livelihoods.

5.7 Limitations and Future Research

Although this study provides valuable insights into the dynamics between training, work environment, and agricultural extension performance, several limitations must be acknowledged. The research was conducted within a single district and focused exclusively on rice cultivation, which may constrain the generalizability of the findings to other regions or agricultural commodities. Future studies should therefore include a broader geographic scope and examine multiple crops to capture variations in environmental conditions, institutional structures, and extension practices. Additionally, the reliance on self-reported performance data may have introduced subjective bias. Integrating complementary perspectives—such as farmer evaluations, supervisory assessments, and objective performance indicators—would provide a more balanced and comprehensive understanding of extension effectiveness. Longitudinal research is also recommended to track how the impacts of training and workplace interventions evolve over time and to assess their contribution to long-term productivity and institutional sustainability.

Overall, this study reaffirms that the synergistic interaction between training and work environment is crucial for enhancing the performance of agricultural extension workers. The empirical results and theoretical interpretations converge on the conclusion that performance improvement arises from the dual foundations of competence and motivation. Training enhances technical capacity and problem-solving ability, while a supportive work environment sustains morale, engagement, and accountability. When these two elements operate in concert, extension systems are better positioned to translate institutional investments into practical benefits for farming communities.

The implications of these findings extend beyond individual capacity development to encompass broader agricultural and developmental outcomes. Extension systems that successfully integrate continuous training with favorable working conditions foster higher productivity, stronger farmer participation, and greater resilience to economic and environmental challenges. Consequently, this study advocates for a comprehensive human resource development strategy that aligns skill enhancement with institutional and environmental support. Such an integrated approach will not only strengthen the performance of extension personnel but also advance the overarching goals of sustainable agricultural growth and national food security.

6. Conclusion

This study concludes that training and work environment jointly play a pivotal role in enhancing the performance of agricultural extension workers in Rajagaluh District. Although neither variable exhibited a statistically significant independent effect, their combined influence explained more than half of the variation in performance, underscoring the synergistic relationship between skill development and supportive institutional conditions. These findings lend empirical support to both Human Capital Theory and Motivation–Hygiene Theory, affirming that capacity-building initiatives yield the greatest impact when reinforced by an enabling and motivating work environment.

The results further demonstrated that improved extension performance contributes directly to higher agricultural productivity, as evidenced by the significant increase in rice yield between 2022 and 2023. This linkage highlights the critical role of extension workers as intermediaries between technological innovation and farmer adoption of best practices. Well-trained and motivated officers effectively translate scientific recommendations into locally applicable actions, thereby facilitating technology diffusion, improving farm efficiency, and supporting rural development.

Overall, the findings confirm that sustainable agricultural productivity depends not only on technological advancement but also on the institutional and human foundations of extension systems. Strengthening these foundations through integrated strategies—combining training, workplace improvement, and motivational mechanisms—can enhance both individual performance and systemic resilience. A holistic approach that aligns technical competence with organizational support will empower extension officers to serve as effective agents of innovation, thereby contributing to long-term food security and community well-being.

7. Recommendations

To reinforce the effectiveness of agricultural extension systems and sustain productivity growth, several policy and managerial actions are recommended:

1. Institutionalize continuous, needs-based training. Extension training programs should be regular, participatory, and tailored to local challenges. The curriculum should emphasize field-based learning, problem-solving, and the integration of both technical and communication skills. Training that incorporates digital literacy and adaptive management will better equip officers to respond to evolving agricultural demands.
2. Improve the physical and digital work environment. Adequate infrastructure, reliable transportation, and access to modern information and communication technologies (ICTs) are essential to improving operational efficiency. The use of mobile advisory platforms, digital data management systems, and online farmer support networks can strengthen information exchange between farmers and institutions while expanding the reach of extension services.
3. Establish robust monitoring, evaluation, and incentive mechanisms. Institutionalize transparent performance appraisal systems that reward high-performing officers and encourage accountability. Evaluation metrics should extend beyond quantitative measures such as the number of visits or training sessions to include qualitative outcomes—particularly farmer adoption rates, satisfaction, and productivity improvements. Well-designed incentive structures can help sustain motivation and commitment among extension personnel.
4. Foster stronger institutional collaboration and policy integration. Collaboration among local governments, agricultural research institutions, universities, and farmer cooperatives should be strengthened to promote resource sharing and coherence in program implementation. Joint initiatives can ensure that research outputs are effectively transferred to the field, while sustained funding partnerships can secure the continuity of extension programs.
5. Implementing these strategies will help create a responsive, capable, and motivated extension workforce capable of bridging the gap between innovation and practice. By aligning human resource development with organizational and technological support, agricultural institutions can ensure that capacity-building efforts translate into lasting improvements in productivity, rural livelihoods, and national food security.

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Conflict of interests

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